



## NORTH CAROLINA LAW REVIEW

Volume 81 | Number 6

Article 8

9-1-2003

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### Recommended Citation

Lori H. Peoples, *A Call for Uniform Regulation of Intentional Introduction of Non-Indigenous Species: The Suminoe Oyster*, 81 N.C. L. REV. 2433 (2003).

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## **A Call for Uniform Regulation of Intentional Introductions of Non-Indigenous Species: The Suminoe Oyster**

The introduction of any non-indigenous species<sup>1</sup> can result in serious environmental and economic harms across large geographic areas. Presently, there is no regulatory framework in North Carolina that would allow persons to object to potentially dangerous introductions of non-indigenous species. The potential introduction of the Suminoe oyster along the Atlantic Coast is indicative of the larger issue of whether there are any controls on the intentional introductions of non-indigenous species. In order to boost a failing oyster industry, the North Carolina Division of Marine Fisheries ("NCDMF") is currently studying the Asian Suminoe oyster for possible introduction into North Carolina's coastal waters.<sup>2</sup> The State of Virginia has also extensively studied the Suminoe oyster. Given the limitations of current federal statutes and common law public nuisance doctrine, the introduction of the Suminoe oyster could carry with it serious consequences that a neighboring state would be powerless to prevent.

This Recent Development will briefly outline the benefits and harms associated with intentional introductions of non-indigenous species, describe current initiatives to introduce the Suminoe oyster on the Atlantic Coast, discuss potential conflicts between neighboring states over intentional introductions as exemplified by the Suminoe oyster, and detail possible legal challenges available to halt this type of intentional introduction. Because legal challenges will most likely be unsuccessful at this point in time, this Recent Development calls for the implementation of federal guidelines to enforce responsible introduction of non-indigenous species into native ecosystems.

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1. The terms "exotic," "alien," "introduced," "non-native," or "non-indigenous" species are used almost interchangeably to describe species that move outside their natural ranges, whether by intentional or accidental introduction. OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, HARMFUL NON-INDIGENOUS SPECIES IN THE UNITED STATES 52 (1993) [hereinafter OTA REPORT], available at <http://www.wws.princeton.edu/cgi-bin/byteserv.pr1/~ota/disk1/1993/9325/9325.PDF>. This Recent Development refers to such species as "non-indigenous species," a term defined in the OTA Report as a "species being beyond its natural range or natural zone of potential dispersal." *Id.* at 53. The term "introduced species" denotes those non-indigenous species that have been intentionally introduced by governmental entities or private citizens for supposedly beneficial purposes.

2. Jerry Allegood, *Asian Oysters Could Replace Natives*, NEWS & OBSERVER (Raleigh, N.C.), Dec. 16, 2002, at B1.

At least one report conservatively estimates that there are 4,500 established non-indigenous species in the United States today.<sup>3</sup> Non-indigenous species can have both beneficial and harmful effects on the environments they occupy. On the positive side, many non-indigenous species have been introduced to re-establish viable industries. For example, the Suminoe oyster, as well as its western counterpart, the Pacific oyster, has been introduced in response to depleted shellfish populations.<sup>4</sup> Likewise, many non-indigenous fish have been introduced to supplement diminishing native fisheries.<sup>5</sup> Additionally, certain fish and other species have been introduced for sporting reasons.<sup>6</sup> Non-indigenous species have been introduced as biological controls for pests and noxious weeds.<sup>7</sup> For example, St. Johnswort (Klamath weed) was introduced in Pennsylvania in 1793 and began its spread throughout the United States.<sup>8</sup> By the 1940s, about five million rangeland acres were considered worthless for grazing purposes because of the weed.<sup>9</sup> Two non-indigenous beetles

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3. OTA REPORT, *supra* note 1, at 3. This number refers only to species with origins outside the United States; it does not include indigenous U. S. species that have been introduced beyond their natural ranges. *Id.* The report emphasizes that the estimate of 4,500 species should be considered a "minimum estimate." *Id.* Indeed, another report cited by the National Council for Science and the Environment estimates that there are 30,000 non-indigenous species in the United States. CONGRESSIONAL RESEARCH SERVICE, CRS REPORT FOR CONGRESS: HARMFUL NON-NATIVE SPECIES: ISSUES FOR CONGRESS III (1999), available at <http://www.ncseonline.org/NLE/CRSreports/Biodiversity/biodv-26b.cfm#Threat%20of%20Harmful> (Apr. 8, 1999).

4. Julianne Kurdila, Comment, *The Introduction of Exotic Species into the United States: There Goes the Neighborhood!*, 16 B.C. ENVTL. AFF. L. REV. 95, 97 (1988). The Pacific oyster was introduced on the West Coast around 1900, and oystermen began importing oyster seed and cultivating the species in places like Willapa Bay, Washington, by 1928. MICHAEL DE ALESSI, COMPETITIVE ENTERPRISE INSTITUTE, OYSTERS AND WILLAPA BAY STUDIES (Mar. 1, 1996), at <http://www.cei.org/utills/printer.cfm?AID=1364> (on file with the North Carolina Law Review). The Pacific oysters eventually began spawning naturally, and today it is estimated that 1 of every 6 oysters harvested in the United States is a Pacific oyster from the Willapa Bay. *Id.*

5. Kurdila, *supra* note 4, at 97.

6. See *id.* (discussing the introduction of the brown trout into the United States by European anglers).

7. *Id.* at 98. The use of non-indigenous species for pest control has its own disadvantages. For example, in Hawaii, the myna bird was introduced as a biological control for cutworms and army worms that were invading sugar cane crops. The myna bird, though controlling the worms, fed on the fruit of the non-indigenous lantana plant, and spread its seeds all over the islands, creating a new pest plant. In response to the rapid spread of the plant, Hawaii introduced another non-indigenous species, a parasitic insect used to help control the lantana. *Id.* at 99.

8. Daniel Simberloff, *Impacts of Introduced Species in the United States*, 2 CONSEQUENCES (1996), <http://gcio.ciesin.org/CONSEQUENCES/vol2no2/article.2.html> (last visited Apr. 15, 2003) (on file with the North Carolina Law Review).

9. *Id.*

were introduced to control the St. Johnswort, and in just ten years it was considered an unimportant roadside weed, reduced to less than one percent of its previous abundance.<sup>10</sup>

Although introducing non-indigenous species offers some benefits, the potential concomitant harmful effects are significant. The harms include adverse effects on native ecosystems and the introduction of disease. For example, the European wild pig was imported into North Carolina in 1912 for hunting.<sup>11</sup> The species quickly spread throughout the Great Smoky Mountains National Park, severely degrading native habitats and altering the ecosystem structure through competition and predation.<sup>12</sup> As exemplified by the European wild pig, non-indigenous species may outcompete indigenous species for food and space and prey on indigenous species. In some cases, the non-indigenous species may hybridize with indigenous species, leading to genetic deterioration of an entire population.<sup>13</sup> They may transport foreign diseases, viruses, and pathogens against which indigenous species have few, if any, defenses.<sup>14</sup> Non-indigenous species may also cause even more unexpected problems such as increased frequency and severity of

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10. *Id.*

11. Daniel P. Larsen, *Combating the Exotic Species Invasion: The Role of Tort Liability*, 5 DUKE ENVTL. L. & POL'Y F. 21, 23 (1995).

12. *Id.* As of the early 1990s, the National Park Service was spending between \$175,000 and \$225,000 annually in its efforts to eradicate the pigs. *Id.*; see also OTA REPORT, *supra* note 1, at 73 (describing the effect of the wild pigs in the Great Smoky Mountains National Park).

13. Kurdila, *supra* note 4, at 101. For example, brook trout introduced into western streams have displaced native bull trout, in part because the hybrid offspring of the two species are sterile, and brook trout genes are not transmitted back into the population. Simberloff, *supra* note 8.

14. Kurdila, *supra* note 4, at 101-02. The chestnut blight fungus, a plant pathogen, was introduced in the United States in the late 19th century. In less than fifty years, it spread over some 225 million acres and destroyed virtually every chestnut tree in the eastern United States. Simberloff, *supra* note 8. The introduction of the Pacific oyster is believed to have resulted in MSX and Dermo, diseases that plague indigenous oysters along the Atlantic Coast today. CHESAPEAKE BAY PROGRAM, NON-NATIVE OYSTERS AND THE CHESAPEAKE BAY, at <http://www.chesapeakebay.net/nonnativeoyster.htm> (last modified Apr. 29, 2002) (on file with the North Carolina Law Review); see also NORTH CAROLINA DIVISION OF MARINE FISHERIES, NORTH CAROLINA OYSTER FISHERY MANAGEMENT PLAN 112 (Aug. 2001), available at <http://www.ncfisheries.net/download/oysFMP.pdf>. MSX, caused by *Haplosporidium nelsoni*, is a disease apparently introduced along the eastern shore in the 1950s along with the commercial introduction of the Pacific oyster. Merrill Leffler, *Crisis and Controversy: Does the Bay Need a New Oyster?*, CHESAPEAKE Q., Fall 2002, at 2, 4, available at [ftp://ftp.mdsg.umd.edu/pub/MDSG/CQ/CQ01\\_3.pdf](ftp://ftp.mdsg.umd.edu/pub/MDSG/CQ/CQ01_3.pdf). Another disease, Dermo, caused by the protozoan *Perkinsus marinus*, also wreaks havoc with native species along the east coast. *Id.* at 5.

fires.<sup>15</sup>

One of the major concerns with the intentional introduction of non-indigenous species is the potential for their expansion into unintended areas, including new geographic habitats and unforeseen niches within their intended geographic ranges.<sup>16</sup> The results of such unintended harms include not only the loss of native biodiversity<sup>17</sup> and introduction of disease, but also enormous economic costs, amounting to billions of dollars each year.<sup>18</sup> As noted in the Office of

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15. See Simberloff, *supra* note 8 (noting how the spread of fire-adapted non-indigenous plants has caused increased numbers of fires, as well as increased severity of fires). Indeed, a fire in a small Oregon town in 1936 resulting in the loss of eleven lives has been blamed on gorse, a highly flammable European plant introduced in the 1860s. *Id.* In Florida, several non-indigenous plants, like the Australian pine, have been identified as fire hazards. *Id.* As a result, approximately 27,000 Australian pines were removed from along the Florida Turnpike. *Id.*

16. OTA REPORT, *supra* note 1, at 61. For example, the cactus moth was introduced in the West Indies to control prickly pear cactus and has since expanded its range into Florida. There is fear that the moth will spread throughout the United States, threatening indigenous prickly pear cacti, sixteen species of which are being reviewed for listing under the Endangered Species Act. *Id.* Another species that preys on aphids, the seven-spotted ladybeetle, has expanded its range throughout the United States and outcompetes indigenous ladybeetles. *Id.* In Hawaii, non-indigenous insects introduced as biological controls for pest insects expanded their diets to include indigenous species. *Id.* Brown trout introduced for sport prey on several indigenous fishes. Kurdila, *supra* note 4, at 100. The brown trout is a large, aggressive fish that has been introduced as a sport fish in many areas because of its tolerance of more degraded environments. OTA REPORT, *supra* note 1, at 64. In some places, the species causes little concern because it exists in habitats where non-indigenous trout are not present. *Id.* But in other areas, like California's Little Kern River, the brown trout has driven indigenous trout to the brink of extinction. *Id.*

17. A discussion of the decline of native biodiversity is beyond the scope of this paper. However, see OTA REPORT, *supra* note 1, at 71–76 for a discussion of the decline of indigenous species, species extinction, transformation of ecosystems, and the loss of biodiversity due to introduction of non-indigenous species. The introduction of non-indigenous species is second only to habitat destruction as a leading cause of the loss of biodiversity. J.T. CARLTON, PEW OCEAN COMMISSIONS, INTRODUCED SPECIES IN U.S. COASTAL WATERS: ENVIRONMENTAL IMPACTS AND MANAGEMENT PRIORITIES 1 (2001), available at [http://www.pewoceans.org/reports/introduced\\_species.pdf](http://www.pewoceans.org/reports/introduced_species.pdf); Viki Nadol, *Aquatic Invasive Species in the Coastal West: An Analysis of State Regulation Within a Federal Framework*, 29 ENVTL. L. 339, 343 (1999).

18. OTA REPORT, *supra* note 1, at 63. This estimate is based on economic losses due to all types of harmful non-indigenous species, including both intentional and non-intentional introductions. See *id.* Although economic loss is estimated to be over \$100 billion annually, the economic value of some introductions is more than \$500 billion annually. See Alan C. Hall, *Costly Interlopers: Introduced Species of Animals, Plants and Microbes Cost the U.S. \$123 Billion a Year*, (Feb. 15, 1999) (stating that ninety-eight percent of the food supply in the United States is the product of non-indigenous species like wheat, rice and domestic cattle), at [http://www.sciam.com/explore\\_directory.cfm](http://www.sciam.com/explore_directory.cfm) (on file with the North Carolina Law Review). Another source estimates the annual cost of introduced species at \$138 billion. ANIMAL AND PLANT HEALTH INSPECTION SERVICE, INVASIVE SPECIES (Apr. 2003) [hereinafter APHIS], at [http://www.aphis.usda.gov/lpa/pubs/fsheet\\_faq\\_notice/fs\\_aphisinvasive.pdf](http://www.aphis.usda.gov/lpa/pubs/fsheet_faq_notice/fs_aphisinvasive.pdf) (on file with the North Carolina Law

## Technology Assessment's Report ("OTA Report"):

The number and impact of harmful [non-indigenous species] are chronically underestimated, especially for species that do not damage agriculture, industry, or human health. Harmful [non-indigenous species] cost millions to perhaps billions of dollars annually. From 1906 to 1991, just 79 [non-indigenous species] caused documented losses of \$97 billion in harmful effects.<sup>19</sup>

One of the most prominent examples of the economic harm caused by non-indigenous species concerns the unintentional introduction of the zebra mussel into the Great Lakes in the mid-1980s.<sup>20</sup> The zebra mussel, which arrived from Europe in ballast water of ships, reproduced rapidly and clogged the water intake pipes of utility plants and virtually every other solid surface in the Great Lakes.<sup>21</sup> The cost of cleaning and redesigning piping systems was estimated at five billion dollars.<sup>22</sup>

Notwithstanding the potential harms and economic costs associated with introductions, state agencies are currently investigating certain non-indigenous species for intentional introduction. An example of one such species is the Suminoe oyster, a non-indigenous species being studied in both North Carolina and the Chesapeake Bay to revive the failing oyster industry.<sup>23</sup> The Suminoe oyster is more resistant to Dermo and MSX, diseases that have decimated oyster populations along the east coast, than native

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19. OTA REPORT *supra* note 1, at 5.

20. Larsen, *supra* note 11, at 24. Although the zebra mussel has been highly publicized, many other non-indigenous species exact staggering costs from taxpayers each year. It is estimated that one-fourth of the country's agricultural gross national product is lost to non-indigenous insects each year. Simberloff, *supra* note 8. For example, since its introduction in the 1890s, the boll weevil has been responsible for \$50 billion in damages. *Id.* Control of aquatic plant species such as the Sri Lankan hydrilla and the Central American water hyacinth costs about \$100 million annually. *Id.* These are but a few examples of the economic losses that can be attributed to non-indigenous species. Notably, these price tags do not include difficult ecological impacts that are difficult to quantify. *Id.*

21. Larsen, *supra* note 11, at 24.

22. *Id.*; see also Simberloff, *supra* note 8 (noting that the cost of the Eurasian zebra mussel is "hundreds of millions of dollars annually").

23. Allegood, *supra* note 2, at B1; Karl Blankenship, *Expanded Use of Nonnative Oyster Seems Likely in Bay*, BAY JOURNAL (Nov. 2001), <http://bayjournal.com/01-11/oyster.htm> (on file with the North Carolina Law Review). In Virginia, oyster harvests of the indigenous Eastern oyster have dropped from around 33 million pounds annually in the 1950s to just 2.5 million pounds in 2002. CHESAPEAKE BAY PROGRAM, *supra* note 14.

oysters.<sup>24</sup> In North Carolina, for example, Dermo and MSX have been blamed for a decline in the oyster harvest from 1.4 million pounds in 1987 to just 257,658 pounds in 2001.<sup>25</sup> In addition, the Suminoe oyster grows at a much faster rate than indigenous species. Suminoe oysters reach market size in only nine months, as opposed to the two years required by indigenous oysters in the Chesapeake Bay<sup>26</sup> and the three years required by indigenous oysters in North Carolina.<sup>27</sup> Faced with declining indigenous populations and the promising results of the Chesapeake Bay study, industry representatives in both regions are pushing for introduction of the Suminoe species.<sup>28</sup>

Although research is not complete in North Carolina, the Virginia Institute of Marine Sciences ("VIMS") has made several findings concerning the Suminoe oyster and the Chesapeake Bay that may be helpful in outlining the potential impacts of an introduction in North Carolina. In 1995, the Virginia General Assembly approved a plan directing VIMS to perform research on non-indigenous oyster species for possible introduction into the waters of the Chesapeake Bay.<sup>29</sup> In 2001, VIMS issued a position statement on the use of the Suminoe oyster in the Chesapeake Bay, cautioning that the intentional introduction of diploid Suminoe into the Chesapeake Bay would be "imprudent" because of the uncertain ecological effects of the introduction.<sup>30</sup> VIMS also advised that aquaculture of triploid Suminoe oysters showed commercial promise, but implementation of such an industry would depend upon the development of adequate security and regulatory measures to prevent accidental

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24. CHESAPEAKE BAY PROGRAM, *supra* note 14. Ironically, both Dermo and MSX are thought to have been introduced by another imported oyster in the 1930s. *Id.*; see also North Carolina Division of Marine Fisheries, *supra* note 14 and accompanying text (discussing the introduction of MSX and Dermo). The two diseases are considered "the leading cause of native oyster mortality" in Virginia. CHESAPEAKE BAY PROGRAM, *supra* note 14.

25. Allegood, *supra* note 2, at B1.

26. CHESAPEAKE BAY PROGRAM, *supra* note 14.

27. Allegood, *supra* note 2, at B1. The introduction of the Suminoe oyster may also provide benefits such as increased water quality due to the filtering effect of the oysters, a reduction in harvesting pressure on native oysters, and depositing of hard substrate for reef development. CHESAPEAKE BAY PROGRAM, *supra* note 14.

28. CHESAPEAKE BAY PROGRAM, *supra* note 14; Allegood, *supra* note 2, at B1.

29. VIRGINIA INSTITUTE OF MARINE SCIENCE, STATEMENT ON THE USE OF *CRASSOSTREA ARIAKENSIS* IN CHESAPEAKE BAY (Nov. 28, 2001), [http://www.mdsg.umd.edu/oysters/exotic/P\\_VIMS.pdf](http://www.mdsg.umd.edu/oysters/exotic/P_VIMS.pdf).

30. *Id.* Diploid oysters have the normal two sets of chromosomes and thus have reproductive capabilities. Blankenship, *supra* note 23. Triploid oysters reared in hatcheries, however, have three sets of chromosomes, which render them sterile. *Id.*

introductions.<sup>31</sup> Such caution is required because there is no guarantee that over time the triploid oysters will not revert to diploid forms or that production errors will not result in a release of reproductively capable forms that could establish self-sustaining wild populations.<sup>32</sup> These wild populations have the potential to introduce new diseases into Atlantic waters, increase competition between the Suminoe oyster and native oysters, and alter native ecosystems.<sup>33</sup>

The North Carolina NCDMF is currently working in connection with the University of North Carolina Institute for Marine Sciences to evaluate the economic feasibility of producing and releasing the triploid Suminoe oyster on a larger commercial scale in North Carolina.<sup>34</sup> Genetically altered sterile oysters are now being studied in the field and will be monitored and removed at the end of the study to ensure that no spawning occurs.<sup>35</sup> If the Suminoe oyster proves economically feasible, the NCDMF will have to decide whether to introduce the species into the wild, and if so, whether to introduce it in its triploid or diploid form.<sup>36</sup> Although NCDMF is not yet prepared to make this decision, there are supporters of such an introduction.<sup>37</sup> According to the director of NCDMF, one reason for such an introduction may be commercial—the state simply does not

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31. Virginia Institute of Marine Science, *supra* note 29.

32. *Id.* The general dangers associated with introducing a non-indigenous species into the wild are discussed *supra* at notes 11–22 and accompanying text.

33. See Eric Hallerman, et al., *Aquaculture of Triploid Crassostrea ariakensis in Chesapeake Bay: A Symposium Report* 6–8 (Oct. 14–19, 2001) (discussing potential hazards of species introduction), at [http://www.mdsq.umd.edu/oysters/exotic/ariakensis01/ariakensis\\_oct01.pdf](http://www.mdsq.umd.edu/oysters/exotic/ariakensis01/ariakensis_oct01.pdf). (on file with the North Carolina Law Review).

34. E-mail from Mike Marshall, Fisheries Management District Manager, North Carolina Division of Marine Fisheries, to Lori Peoples (Jan. 27, 2003., 11:14:15 EST) (on file with the North Carolina Law Review).

35. *Id.*

36. *Id.* The purpose of introducing the sterile or triploid form of the Suminoe would be to prevent reproduction or hybridization with native populations. However, such sterilization procedures are not always totally effective. See *supra* notes 13 and 30 and accompanying text.

37. See Patricia Smith-Heupel, *State Wants to Control Non-Native Oyster Spread*, JACKSONVILLE DAILY NEWS, Jan. 31, 2003, at 3A (identifying Dare County Democratic Sen. Marc Basnight as a supporter of the introduction and quoting DMF Director Preston Pate as saying that “[t]here is certainly a lot of support for the introduction”), available at <http://www.jacksonvilledailynews.com> (on file with the North Carolina Law Review). Unfortunately, some political players do not recognize the well-documented need for caution in introducing non-indigenous species. Senator Basnight’s aide, Rolf Blizzard, has been quoted regarding the Suminoe oyster: “[l]et’s say they do escape into the wild. The worst thing you’d have is a bunch of the waters of the state infested with oysters and that’s what we want.” Patricia Smith-Heupel, *Non-Native Oysters Show Promise*, JACKSONVILLE DAILY NEWS, Sept. 1, 2002, at 1A, available at <http://www.jacksonvilledailynews.com> (on file with the North Carolina Law Review).



want to be "left behind" if other states decide to introduce the Suminoe.<sup>38</sup>

Meanwhile, in Virginia, many oyster industry representatives are pushing for a release of the diploid oyster in the Chesapeake Bay as early as 2003.<sup>39</sup> Indeed, several counties have already called for the release of diploid Suminoe oysters into the Chesapeake Bay.<sup>40</sup> This pressure to release the oyster continues notwithstanding the warnings from VIMS concerning the introduction of reproductive diploid oysters. As VIMS notes, apart from potential biological harms associated with the intentional introduction, the decision to introduce diploid Suminoe oysters into the Chesapeake Bay potentially affects the entire Atlantic Coast.<sup>41</sup> Such a decision should involve all interested parties "for the obvious reasons that colonization is enabled by larval transport and that the risks and merits of this species may vary spatially."<sup>42</sup> Because of colonization and transport, "[t]he status of an invasive species in one state is likely to be an accurate forecast of how successful the species will be in a neighboring state, provided that the ecosystem is contiguous or sufficiently similar to support the species."<sup>43</sup> Such potential colonization and the unpredictable consequences of introducing the species are the reasons Maryland opposes any such introduction of the oyster in either triploid or diploid form.<sup>44</sup>

The case of the Suminoe introduction is indicative of a larger issue—whether there are any controls on the intentional introduction of non-indigenous species. Of paramount importance to this issue is whether states have any legal recourse to stop intentional introductions whereby species may expand their ranges across state lines and endanger native ecosystems. Unfortunately, states have few means of addressing such action, even though the introduction of non-indigenous species may adversely impact the state in numerous

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38. Allegood, *supra* note 2, at B1.

39. Blankenship, *supra* note 23; *see also* CHESAPEAKE BAY PROGRAM, *supra* note 14 (noting that the Virginia Seafood Council and other watermen support the introduction of the Suminoe oyster into the Chesapeake Bay).

40. Blankenship, *supra* note 23.

41. Virginia Institute of Marine Science, *supra* note 29.

42. *Id.*; *see also* Nadol, *supra* note 17, at 350.

43. Nadol, *supra* note 17, at 350. *See generally* Carlton, *supra* note 17, at 15 (discussing coastal dispersion of aquatic introductions).

44. Blankenship, *supra* note 23 (quoting Carolyn Watson, Assistant Secretary of the Maryland Department of Natural Resources); *see also* Hallerman, *supra* note 33, at 9 (noting that, although most participants agreed with a cautious approach to introducing triploid oysters in the Chesapeake Bay, Maryland representatives oppose an introduction in any form).

ways.<sup>45</sup> For this reason, Congress must implement federal guidelines to provide for the responsible introduction of non-indigenous species into native ecosystems.

Although federal law may preempt state law concerning the regulation of non-indigenous species in certain situations,<sup>46</sup> for the most part, states retain almost unlimited power over the introduction of non-indigenous fish and wildlife species within their borders.<sup>47</sup> Accordingly, states will have little control over intentional releases by neighboring states.<sup>48</sup> However, both the Endangered Species Act and the National Environmental Policy Act provide some potential mechanisms for addressing intentional introductions of non-indigenous species.

The Endangered Species Act ("ESA")<sup>49</sup> may be used to indirectly challenge intentional introductions of non-indigenous species. In *Palila v. Hawaii Department of Land and Natural Resources*,<sup>50</sup> the Sierra Club brought suit to require Hawaiian officials to remove non-indigenous goats and sheep that had been placed on the island to promote hunting. The animals fed on a native tree that provided the main food source and shelter for an endangered bird, the palila.<sup>51</sup> The Ninth Circuit held that maintaining the non-indigenous populations of goats and sheep violated section 9 of the ESA since their activity resulted in "significant environmental modification or degradation" of the palila's habitat, thus endangering the birds.<sup>52</sup> Following that rationale, if the intentional introduction of a non-indigenous species significantly affects a threatened or endangered species, states or other private parties may have power to prevent such an introduction under the ESA.<sup>53</sup> As noted in the OTA

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45. See *supra* notes 11–22 and accompanying text (discussing the harmful effects of introducing non-indigenous species into native habitats).

46. There are federal plans such as the Plant Protection Act that set national policies for certain plant species. See generally Plant Protection Act, Pub. L. 106-224, 114 Stat. 438 (2000) (codified as amended in scattered sections of 7 U.S.C.). This type of preemption is usually found with regard to agricultural laws rather than fish and wildlife. OTA REPORT, *supra* note 1, at 202. Where comprehensive federal regulations exist, courts have deemed state lawsuits preempted. See *infra* note 98.

47. OTA REPORT, *supra* note 1, at 201–02.

48. *Id.* at 202.

49. Endangered Species Act of 1973, Pub. L. 93-205, 87 Stat. 884 (codified as amended at 16 U.S.C.A. §§ 1531-1544 (West 2000 & Supp. 2003)).

50. 639 F.2d 495 (9th Cir. 1981).

51. *Id.* at 496.

52. *Id.* at 497.

53. See generally Larsen, *supra* note 11, at 29–31 (discussing the role of the *Palila* decision and control of exotics under the ESA). The ESA makes specific provisions for citizen suits whereby a private individual can file a lawsuit to enjoin any person or

Report: “[u]nder [the *Palila* reasoning], other States could be compelled to manage [non-indigenous species] to prevent conflicts with threatened or endangered species. Thus, precedents exist for federal preemption even in the traditionally state dominated area of fish and wildlife management.”<sup>54</sup> However, this approach would be of limited use since it depends on a non-indigenous species’ impact to a listed endangered or threatened species.<sup>55</sup>

Another limited avenue to prevent intentional introductions of non-indigenous species theoretically comes under the National Environmental Policy Act (“NEPA”).<sup>56</sup> NEPA is a procedural statute requiring the preparation of an Environmental Impact Statement (“EIS”) whenever a major federal action significantly affects the environment.<sup>57</sup> However, courts are extremely limited in reviewing an EIS. The court will “evaluate the EIS simply to determine whether it ‘contains a reasonably thorough discussion of the significant aspects of the probable environmental consequences’ of a challenged action.”<sup>58</sup> The Chesapeake Bay Program Federal Agencies Committee cautioned that “it is likely that [Suminoe] aquaculture in the open water of the Chesapeake Bay would require . . . an environmental impact assessment and alternatives analysis under the National Environmental Policy Act.”<sup>59</sup> Although academic literature discusses the possibility of using NEPA challenges,<sup>60</sup> there is little case law exploring such an option.<sup>61</sup> Given

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governmental instrumentality from violating the Act. § 1540(g).

54. OTA REPORT, *supra* note 1, at 204. Other federal enactments such as the Lacey Act also preempt state wildlife regulation to a limited degree. See CONGRESSIONAL RESEARCH SERVICE, CRS REPORT FOR CONGRESS: HARMFUL NON-NATIVE SPECIES: ISSUES FOR CONGRESS IV (1999), available at <http://www.ncseonline.org/NLE/CRSreports/Biodiversity/biodv-26c.cfm#Laws> (on file with the North Carolina Law Review). The Lacey Act, for example, addresses interstate commerce and prohibits the possession, transportation, or sale of any fish, wildlife, or plant material taken in violation of state or foreign law. *Id.*

55. Larsen, *supra* note 11, at 30–31.

56. See generally National Environmental Policy Act of 1969, Pub. L. 91-190, 83 Stat. 852 (1970) (codified as amended in scattered sections of 42 U.S.C.A. (West 1994 & Supp. 2003)).

57. See *id.*

58. Nat’l Parks & Conservation Ass’n v. U.S. Dept. of Transp., 222 F.3d 677, 680 (9th Cir. 2000) (quoting Oregon Envtl. Council v. Kunzman, 817 F.2d 484, 492 (9th Cir. 1987) (citations omitted)).

59. DIANA ESHER, CHESAPEAKE BAY PROGRAM, RECOMMENDATIONS ON THE SUMINOE OYSTER (*CRASSOSTREA ARIAKENSIS*) AQUACULTURE IN CHESAPEAKE BAY (Dec. 20, 2001), at <http://www.chesapeakebay.net/pubs/oyster.pdf> (on file with the North Carolina Law Review).

60. *Id.*

61. To date, there do not appear to be any supporting cases where NEPA challenges

the nature of NEPA itself, it is unlikely that such challenges will be successful.

For example, in *National Parks & Conservation Ass'n v. United States Department of Transportation*,<sup>62</sup> conservation groups brought suit against the Federal Aviation Administration challenging an EIS prepared in anticipation of the expansion of an airport runway.<sup>63</sup> Conservation groups claimed the agency did not properly address possible introductions of non-indigenous species from increased air traffic in granting approval for the project.<sup>64</sup> In affirming the agency's decision, the court noted: "[w]e need not agree with the agency's conclusions; we must approve the EIS if we are satisfied that the EIS process fostered informed decision-making and public participation."<sup>65</sup>

Although *National Parks* arose in the context of a project that merely had potential for the introduction of non-indigenous species, it is useful in understanding the reviewing court's role in addressing NEPA challenges. As long as an agency carefully considers the impact of a possible introduction, it is highly unlikely a reviewing court will overturn its decision. "If the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh the environmental costs."<sup>66</sup> Given the extensive research going into possible introductions of the Suminoe oyster, it is unlikely that a NEPA challenge would be successful in overturning a state agency's decision to implement such a program as long as the agency had considered the research.

The ESA and NEPA provide some mechanisms for challenging intentional introductions, but they are limited in their application. Thus, a federal lawsuit may be the only method for resolving state disputes over the introduction of non-indigenous species.<sup>67</sup> However, such suits are rare. For example, North Dakota conducted an experimental release of the European zander for sport fishing,

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have been brought opposing the intentional introduction of non-indigenous species at either the state or federal level.

62. 222 F.3d 677 (9th Cir. 2000).

63. *Id.* at 677.

64. *Id.* at 679.

65. *Id.* at 680.

66. *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989); *see also Nat'l Parks*, 222 F.3d at 683 (Fletcher, J. dissenting) (quoting with approval the language from *Robertson v. Methow Valley Citizens Council*, describing the procedural nature of the National Environmental Policy Act).

67. OTA REPORT, *supra* note 1, at 208.

notwithstanding vigorous objections by neighboring Minnesota.<sup>68</sup> Although the State objected to the introduction, Minnesota officials still "supported the principle of paramount State sovereignty over natural resources" by declining to bring suit, and North Dakota proceeded with its experimental release.<sup>69</sup> As exemplified by this stance, states will be unlikely to advocate for less state sovereignty.<sup>70</sup> The result is that states lack the power to prevent the intentional introduction of a non-indigenous species, even when the state itself has banned the particular species. Such a situation occurred in the 1970s with the introduction of the grass carp in Arkansas.<sup>71</sup> The State of Missouri previously banned the grass carp and opposed the introduction of the species in Arkansas.<sup>72</sup> Nonetheless, Arkansas went ahead with its release of the carp. Consequently, "Missouri was forced to succumb to the carp invasion into its waters. Missouri must now confront the problems caused by a neighboring state's exotic introduction."<sup>73</sup>

One potential avenue of attack on the introduction of non-indigenous species may fall within public nuisance doctrine. A public nuisance is "an unreasonable interference with a right common to the general public."<sup>74</sup> In order for a private citizen to maintain a public nuisance suit, the private individual must be able to show some specialized injury that is different from the harm to the general public.<sup>75</sup> If private plaintiffs cannot show some special injury, then only public representatives may bring the nuisance suit.<sup>76</sup>

Although the use of common law public nuisance lawsuits has been discussed as a solution to the unintentional introduction of non-indigenous species, its applicability to intentional introductions is worth investigation.<sup>77</sup> Public nuisance doctrine has been used to

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68. *Id.* at 207; see Kurdila, *supra* note 4, at 109-10 (providing a description of the objections to the zander introduction).

69. OTA REPORT, *supra* note 1, at 207.

70. *Id.*

71. Kurdila, *supra* note 4, at 110.

72. *Id.*

73. See *id.* (citing telephone conversation with Jim Fry, Missouri Conservation Department (Oct. 1987)).

74. RESTATEMENT (SECOND) OF TORTS § 821B (1977).

75. *In re Starlink Corn Products Liab. Litig.*, 2 F. Supp. 2d 828, 848 (N.D. Ill. 2002).

76. Larsen, *supra* note 11, at 55.

77. See *id.* at 35-36 (discussing the idea that public nuisance suits could be used to supplement statutory schemes governing intentional introductions, but that "[p]ublic nuisance liability provides the best solution to prevent totally unintentional introductions").

challenge a variety of environmental harms.<sup>78</sup> For instance, public nuisance doctrine has been used to control air pollution and as a basis for the codification of federal water pollution controls.<sup>79</sup> As one commentator notes, “[s]ince exotic species often act as pollutants, their introduction into foreign ecosystems can create public nuisances comparable to oil spills, hazardous waste discharges, and other events causing damage to public environmental resources. . . . [E]xotic species are potentially more dangerous to ecosystems than any other human pollutant.”<sup>80</sup>

Although public nuisance has traditionally been confined to addressing interference with public rights such as public health, safety, comfort, or convenience, “public nuisance law is capable of adapting and progressing with evolving societal values.”<sup>81</sup> In addition to the traditional public rights addressed by public nuisance doctrine, there is much inherent flexibility in the doctrine whereby the health of a native ecosystem could become a protected public right.<sup>82</sup> At least one court has recognized that public nuisance claims can be brought for interference with native ecosystems.<sup>83</sup> Although the court recognized the availability of nuisance doctrine in this context, the court’s decision was based on a statutory provision labeling as nuisances those forms of exotic wildlife that had escaped control and been determined to be detrimental to native wildlife.<sup>84</sup> This case presents evidence that the introduction of non-indigenous species and consequent damage to native ecosystems may be within the purview

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78. *Id.*

79. *See id.* at 39–40 & n.110. Indeed, public nuisance law “is the common law backbone of modern environmental and energy law.” *Id.* at 39 (quoting WILLIAM H. RODGERS, HANDBOOK ON ENVIRONMENTAL LAW 100 (1977)).

80. *Id.* at 51–52.

81. *Id.* at 40–42. For a discussion of the elements of a public nuisance suit, see *id.* at 40–50. One of the important factors to note in pursuing a public nuisance suit is that both public officials and private citizens who have some “special injury” may maintain such suits. *Id.* at 41. For example, courts have ruled that commercial fishermen suffered special injury when the local waters where they fished were contaminated by oil pollution. *Burgess v. M/V Tamano*, 370 F. Supp. 247, 250 (D. Me. 1973). Similarly other courts have held that commercial corn farmers had standing to challenge contamination of the general corn supply. *In re Starlink Corn Prods. Liab. Litig.*, 212 F. Supp. 2d 828, 848 (N.D. Ill. 2002). The ability of private citizens to bring suit on nuisance claims is especially important given the reluctance of states to bring suit against each other. *See supra* notes 66–70 and accompanying text.

82. *See* Larsen, *supra* note 11, at 38–39 (discussing the adaptability of public nuisance doctrine and its application to environmental issues).

83. *Colorado Div. of Wildlife v. Cox*, 843 P.2d 662 (Colo. Ct. App. 1992).

84. *Colorado Div. of Wildlife v. Cox*, 843 P.2d 662, 663 (Colo. Ct. App. 1992); *see also* Larsen, *supra* note 11, at 52–53 (discussing the Colorado statute and holding of *Colorado Div. of Wildlife v. Cox*).

of public nuisance law.<sup>85</sup> Such a trend in evolving values is also evidenced by the recent use of public nuisance doctrine in regulating genetically modified organisms ("GMOs").<sup>86</sup>

The problem with using public nuisance doctrine to control intentional introductions of non-indigenous species is that a nuisance suit may not prevent the introduction entirely. The remedies available to private citizens suing for public nuisances include damages and injunctions to halt the nuisance.<sup>87</sup> But, once a non-

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85. *Id.* at 53.

86. Genetically modified organisms ("GMOs") are organisms created through recombinant DNA technology. See Thomas P. Redick & Christina G. Bernstein, *Nuisance Law and the Prevention of "Genetic Pollution": Declining a Dinner Date with Damocles*, 30 ENVTL. L. REP. 10,328, 10,328 (2000). With DNA technology, the selected genes of one species are transferred to another species to produce the GMO. Amelia P. Nelson, Note, *Legal Liability in the Wake of Starlink™: Who Pays in the End?*, 7 DRAKE J. AGRIC. L. 241, 243 (2002). In the agricultural context, such genetic engineering is used to increase insect tolerance, resistance to herbicides, yield, and nutritional benefits of crops. *Id.* at 218. In 2001, GMO crops made up twenty-six percent of total corn crops and sixty-eight percent of total soybean crops. *Id.* at 216.

Public nuisance doctrine may be used in the GMO context with pollen drift or outcrossing and with commingling of GMO and non-GMO crops in the stream of commerce. *Id.* at 231. Thus, a lawsuit based on public nuisance could seek an injunction against the sale of certain GMOs. *Id.* "The chain of commerce may be protected if the authority enforcing public nuisance considers the commodity export stream to represent a significant public health right needing protection." Redick & Bernstein, *supra*, at 10,334). Public nuisance doctrine has already been used in an attempt to regulate GMOs. In *In re Starlink Corn Products Liability Litigation*, corn farmers were allowed to bring a public nuisance claim against the manufacturer of a genetically modified corn. 212 F. Supp. 2d 828, 828 (N.D. Ill. 2002). The basis of the claim was that "Starlink's contamination of the general food corn supply constitute[d] a public nuisance." *Id.* at 848. In another case, plaintiffs have filed a class action complaint against GMO seed manufacturers alleging a public nuisance created by "mass marketing GM [genetically modified] crops in the United States without control or prevention of GM crops contaminating non-GM crops . . . and without adequate long-term testing for environmental and human health safety." First Amended Class Action Complaint at 47-48, *Sample v. Monsanto Co.*, No. 4:01cv00065RWS (E.D. Mo.), available at <http://www.cmht.com/casewatch/cases/monsanto-amcomcompl.pdf> (on file with the North Carolina Law Review). The application of public nuisance doctrine to GMOs is especially relevant considering the similar threats GMOs and non-indigenous species pose. For example, the USDA's Animal Plant Health Inspection Service ("APHIS") monitors the introduction of GMOs, among other things, for potential impacts including the weediness of the proposed crop, the unintended transfer of genes, and impacts on beneficial insects. GENETICALLY ENGINEERED ORGANISMS PUBLIC ISSUES EDUCATION PROJECT (GEO-PIE), U.S. REGULATION OF GENETIC ENGINEERING [hereinafter U.S. Regulation], at <http://www.geo-pie.cornell.edu/regulation/reg.html> (last updated May 9, 2002) (on file with the North Carolina Law Review). These are some of the same threats posed by non-indigenous species—introduction of diseases, viruses, or pathogens, hybridization and genetic dilution, and unintended impacts on native species. See *supra* notes 11-25 and accompanying text. Indeed, APHIS's traditional role was to monitor and control non-indigenous species. See U.S. Regulation.

87. Larsen, *supra* note 11, at 50-51.

indigenous species is introduced into the wild, it may not be possible to contain or remove it entirely. The key to the success of public nuisance suits would be obtaining injunctions against intentional introductions before those introductions occurred. This solution is analogous to an injunction against the sales of certain GMO crops because of their threats to the public interest in agricultural trade or to an injunction against the planting of certain GMOs because of the known threat of commingling.<sup>88</sup> If courts were to recognize a public right in a healthy native ecosystem to the same extent that they recognize a public right in health or safety issues, public nuisance suits might become a powerful tool for halting such introductions and recovering damages.<sup>89</sup> Although public nuisance doctrine may one day provide an avenue for attacking intentional introductions, it is not likely that such suits will prove effective in controlling non-indigenous species at this point in time. The idea of protecting native ecosystem health, while potentially within the purview of nuisance doctrine, has not yet evolved into a firm reality.

Because federal statutes like the Endangered Species Act and the National Environmental Policy Act are limited in their applicability to the introduction of non-indigenous species, and there is scant federal regulation in the area, states may have little recourse to control introductions. Considering the unlikely success of nuisance claims, North Carolina may have little choice about whether the Suminoe oyster will occupy its waters. Even if the state decides not to proceed with the introduction, it will be unable to prevent Virginia from releasing the Suminoe oyster in the Chesapeake Bay. Likewise, States like Maryland, that oppose such introductions, will have no legitimate means of stopping such action.

Another solution is that of cooperative programs administered by state and federal agencies in conjunction with industry, non-governmental organizations and the like—especially in the context of aquatic introductions.<sup>90</sup> The OTA Report states: “[i]ntroduced aquatic organism issues are inherently interjurisdictional and, thus, clearly national, indeed international in scope. . . . the Federal Government should function as a catalyst/facilitator establishing incentives for action by the States and the other co-managers of the

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88. Redick & Bernstein, *supra* note 86, at 10,334–35, 10,337–38

89. *But see* Larsen, *supra* note 11, at 41 (discussing the idea that “[p]ublic nuisances define the effect of an activity rather than the activity itself. . . . If the condition created by the action unreasonably and substantially interferes with a public right, the condition is a public nuisance.”).

90. OTA REPORT, *supra* note 1, at 203.



Nation's fishery resources."<sup>91</sup>

Such a cooperative program currently exists in the Chesapeake Bay. However, its success is in question in the case of the Suminoe oyster introduction. The Chesapeake Bay Program is a regional partnership committed to restoring the Chesapeake Bay.<sup>92</sup> Partners to the program include states (Pennsylvania, Virginia, and Maryland), the District of Columbia, federal agencies (EPA, United States Fish and Wildlife Service), academic groups (VIMS, Chesapeake Research Consortium), and non-governmental groups (Chesapeake Bay Foundation, Anacostia Watershed Society) among others.<sup>93</sup> Notwithstanding this extensive regional cooperative program, Virginia is working diligently to release the Suminoe oyster into the wild, even if only in triploid form.<sup>94</sup> However, the State of Maryland, one of the Program partners, has staunchly opposed the use of the Suminoe in the Bay in any form.<sup>95</sup> The bottom line is that Virginia may have economic incentives that drive it to introduce the Suminoe oyster, in direct contravention of the desires of at least one of the Chesapeake Bay Program's partners.<sup>96</sup> Although "many States require approval by the regional council or commission as a prerequisite for certain [non-indigenous species] introductions. . . . [r]egional organizations are limited in that they are essentially voluntary . . . . Moreover, they have no independent regulatory authority."<sup>97</sup>

The potential intentional introduction of the Suminoe oyster into the Chesapeake Bay and into North Carolina's coastal waters is just one example of a state introducing non-indigenous species for

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91. *Id.* (quoting FISH AND WILDLIFE SERVICE, U.S. DEPT. OF INTERIOR, POLICIES FOR REDUCING RISKS ASSOCIATED WITH INTRODUCTIONS OF AQUATIC ORGANISMS (1987)).

92. CHESAPEAKE BAY PROGRAM, OVERVIEW OF THE BAY PROGRAM: AMERICA'S PREMIER WATERSHED RESTORATION PROGRAM, at <http://www.chesapeakebay.net/overview.htm> (last modified Mar. 14, 2001) (on file with the North Carolina Law Review).

93. CHESAPEAKE BAY PROGRAM, BAY PROGRAM PARTNERS, at <http://www.chesapeakebay.net/baypartners.htm> (last modified Mar. 13, 2003) (on file with the North Carolina Law Review).

94. See *supra* notes 29–32, 39–41 and accompanying text; Scott Harper, *Best Hope for the Bay?*, VIRGINIAN-PILOT, July 30, 2002 at A1 (reporting that "state lawmakers passed a nonbinding resolution giving researchers three years to prove that the non-native species is indeed troublesome. Absent that proof, Asian oyster farming can begin.").

95. *Supra* note 44 and accompanying text.

96. Cf. OTA REPORT, *supra* note 1, at 207 (discussing the fact that with an earlier attempted introduction of the Pacific oyster "Virginia has a greater economic incentive to promote the introduction than Maryland, which still maintains a viable oyster fishery based on the indigenous species").

97. *Id.* at 208.

commercial purposes, and it is indicative of broader concerns over the introduction of such species. As native fisheries continue to decline, economic concerns may lead more and more states down the path of introduction. Because no real power currently exists for affected states to oppose such introduction, the federal government should promulgate guidelines for the introduction of non-indigenous species.<sup>98</sup> However, current federal regulations provide little guidance on how to implement and enforce such a program. For example, although there is a patchwork of federal regulations addressing organisms like aquatic nuisance species, for the most part, such legislation is aimed at unintentional introductions of non-indigenous species.<sup>99</sup> The legislation that is now in effect suffers from a narrow focus and the lack of an enforcement mechanism.<sup>100</sup> The most promising federal movement towards uniform guidelines for the introduction of non-indigenous species was prompted by an Executive Order issued by President Carter.<sup>101</sup> The Order empowered the Secretaries of the Interior and Agriculture "to promulgate and implement uniform rules and regulations governing the introduction of exotics into United States ecosystems."<sup>102</sup>

Unfortunately, President Carter's proposed guidelines were never implemented.<sup>103</sup> Instead, in 1999, President Clinton issued an executive order repealing President Carter's executive order.<sup>104</sup> Although President Clinton's order established an Invasive Species Council whose purpose was to issue an Invasive Species Management Plan, the order dealt primarily with federal agency action affecting

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98. The lack of uniform federal regulation may be one reason public nuisance claims could succeed. The Supreme Court has consistently held that comprehensive federal environmental regulation preempts state nuisance claims. Randy Lowell, *Private Actions and Marine and Water Resources: Protection, Recovery and Remediation*, 8 S.C. ENVTL. L.J. 143, 168 (2000); see also, David R. Hodas, *Private Actions for Public Nuisance: Common Law Citizen Suits for Relief from Environmental Harm*, 16 ECOLOGY L.Q. 883, 903-04 (1989) (discussing federal preemption of state common law public nuisance claims in certain situations).

99. See Kristen M. Fletcher, "If You Can't Beat 'Em, Eat 'Em:" *Legal Methods to Control Aquatic Nuisance Species in the Gulf of Mexico*, 5 OCEAN & COASTAL L.J. 245, 249-52 (2000).

100. See *id.* (discussing the fact that the Non-Indigenous Aquatic Nuisance Species Prevention and Control Act (NANCPA) and the National Invasive Species Act (NISA) are narrow in scope because the mandatory regulations are limited to the Great Lakes region).

101. Kurdila, *supra* note 4, at 103.

102. *Id.* (citing Exec. Order No. 11987, 3 C.F.R. 116 (1977), reprinted in 42 U.S.C. § 4321, (1982)).

103. Kurdila, *supra* note 4, at 103.

104. Exec. Order No. 13,112, 64 Fed. Reg. 6183 (Feb. 8, 1999).

non-indigenous species.<sup>105</sup> The purpose of the order was to “prevent the introduction of invasive species and provide for their control,” but it only directs federal agencies “whose actions may affect the status of invasive species” to take certain measures to control those introductions.<sup>106</sup> Thus, the order is limited in scope, as it only addresses federal actions.

The Animal and Plant Health Inspection Service (“APHIS”) cited President Clinton’s executive order as the impetus and basis for its work in preventing “pests and diseases that threaten the Nation’s biological resources from becoming established in the United States.”<sup>107</sup> In its current form, however, APHIS is more concerned with non-indigenous species that affect agriculture.<sup>108</sup>

With a lack of federal guidelines for the introduction of non-indigenous species, states’ only recourse may be cooperative regional plans. However, without any type of enforcement power, these regional plans are dependent upon a state’s willingness to participate. If state economic incentives against participation outweigh the benefits or purposes of the partnership, a state may simply withdraw.<sup>109</sup> Thus, notwithstanding the cooperative agreement, Maryland may have little recourse if Virginia decides to introduce either triploid or diploid oysters into the Chesapeake Bay. Similarly, if North Carolina decides the potential harms associated with introducing the Suminoe oyster into its waters outweigh any commercial benefits, it will be powerless to stop Virginia from introducing the species.

Federal regulations that include effective enforcement mechanisms are necessary to ensure responsible introduction of non-indigenous species.

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105. *Id.*

106. *Id.*

107. APHIS, *supra* note 18.

108. GENETICALLY ENGINEERED ORGANISMS PUBLIC ISSUES EDUCATION PROJECT (GEO-PIE), USDA ANIMAL AND PLANT HEALTH INSPECTION SERVICE (“APHIS”), at <http://www.geo-pie.cornell.edu/regulation/APHIS.html> (on file with the North Carolina Law Review). *But see* APHIS, *supra* note 18 (stating that “APHIS is also actively engaged in controlling certain types of invasive species and vertebrate pests that affect native ecosystems, rather than agricultural resources”).

109. For example, although there is a “clear need for interstate cooperation . . . the members of the Pacific Marine Fisheries Commission have largely gone their own ways since the efforts of the 1970s and early 1980s.” OTA REPORT, *supra* note 1, at 208.